

Isabelle/jEdit — a Prover IDE within the PIDE framework

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1 Overview

PIDE is a general framework for document-oriented prover interaction and integration, based on a bilingual architecture that combines ML and Scala [2]. The overall aim is to connect LCF-style provers like Isabelle [5, §6] (or Coq [5, §4] or HOL [5, §1]) with sophisticated front-end technology on the JVM platform, overcoming command-line interaction at last.

The present system description specifically covers Isabelle/jEdit as part of the official release of Isabelle2011-1 (October 2011). It is a concrete Prover IDE implementation based on Isabelle/PIDE library modules (implemented in Scala) on the one hand, and the well-known text editor framework of jEdit (implemented in Java) on the other hand.

The interaction model of our Prover IDE follows the idea of continuous proof checking: the theory source text is annotated by semantic information by the prover as it becomes available incrementally. This works via an asynchronous protocol that neither blocks the editor nor stops the prover from exploiting parallelism on multi-core hardware. The jEdit GUI provides standard metaphors for augmented text editing (highlighting, squiggles, tooltips, hyperlinks etc.) that we have instrumented to render the formal content from the prover context. Further refinement of the jEdit display engine via suitable plugins and fonts approximates mathematical rendering in the text buffer, including symbols from the \TeX repertoire, and sub-/superscripts.

Isabelle/jEdit is presented here both as a usable interface for current Isabelle, and as a reference application to inspire further projects based on PIDE.

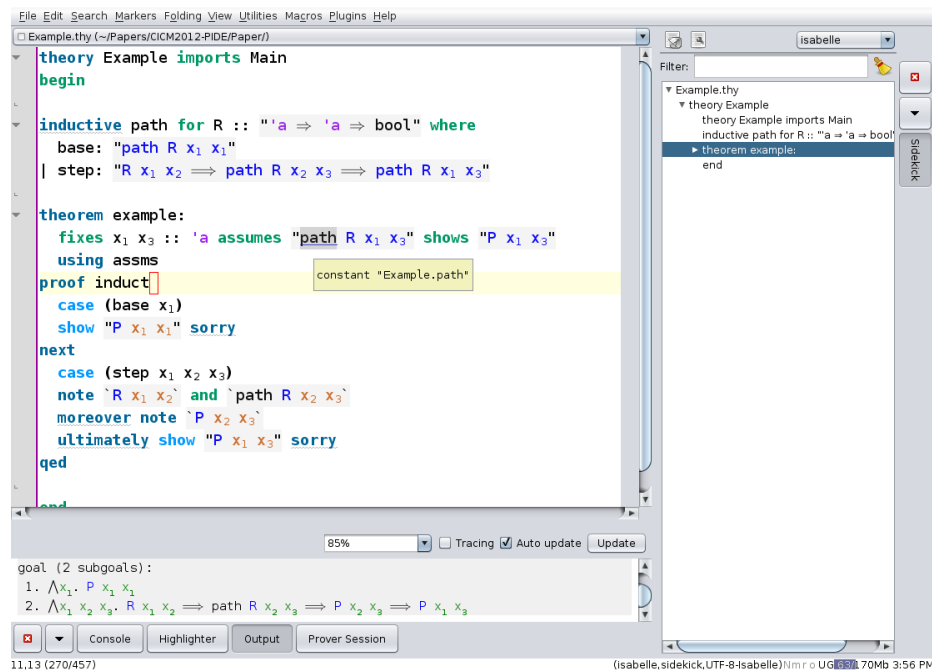
2 Using the System

The described system is part of the official release Isabelle2011-1 (October 2011). The download archives from <http://isabelle.in.tum.de/website-Isabelle2011-1/download.html> cover the three main platform families: Linux, Mac OS X, and Windows (with Cygwin). Isabelle/jEdit has already a history of about 4 years; a preliminary version is discussed in [3]. October 2011 marks the point of the first stable release of the Prover IDE; some remaining limitations are described in

its README panel. The website <http://isabelle.in.tum.de> points dynamically to the latest official release, and further improvements of Isabelle/jEdit can be anticipated with coming Isabelle distributions.

The Isabelle distribution bundles sources and multi-platform binaries, including Isabelle/jEdit. Conceptually, the Prover IDE is a *rich-client platform* with significant hard-disk foot-print, but it runs seamlessly for most users. The shell command `Isabelle2011-1/bin/isabelle jedit` opens a text editor session of jEdit which we have augmented by some plugins to communicate with the prover in the background. Source files with `.thy` extension are treated specifically: Isabelle/jEdit adds them to the formal document-model of Isabelle/PIDE, that maintains semantic information provided by the prover in the background, while the user is editing the text in the foreground.

The subsequent screenshot shows the editor view after opening a certain `Example.thy` file. The Isabelle distribution contains many other examples, e.g. `Isabelle2011-1/src/HOL/Unix/Unix.thy` where the editor will also propose to load further imported theory files.



The main text area is surrounded by *dockable windows* that are associated with jEdit plugins. For example, we provide *Output* for prover messages and traditional goal states, which is internally based on existing HTML4/CSS2 rendering on the JVM. The tree view is provided by *Sidekick*, which is an existing jEdit plugin that has been instrumented to understand some Isabelle theory structure.

The general aim of Isabelle/jEdit is to expose the specific virtues of both Isabelle and jEdit to the user, without accidental technical limitations imposed

on either system. This is in contrast to the classic Proof General / Emacs [1], where the *locked region* is essentially an intrusion of the prover command prompt into the editor; it restricts the user to a single focus inherited from TTY mode.

Having replaced the prover Read-Eval-Print-Loop by native document editing in Isabelle/PIDE, we can connect the editor more directly. The sophisticated features that qualify jEdit as “Programmer’s Text Editor”¹ are retained, and augmented by the semantic information from the prover. The underlying JVM platform is sufficiently flexible to support our requirements for this formal document-model, but instead of Java we are always using Scala [2] for our own implementations. Higher-order functional-object-oriented programming on multi-threaded JVM is far removed from untyped single-threaded Emacs-Lisp.

Physical rendering of document content draws from the standard repertoire of known IDEs for programming languages, with highlighting, squiggles, tooltips, hyperlinks etc. In the above screenshot, only the bold keywords of the Isar language use traditional syntax-highlighting in jEdit with static tables; all other coloring is based on dynamic information from the logical context of the prover.

Such annotated text regions can be explored further by using the **CONTROL** modifier key (or **COMMAND** on Mac OS X), together with mouse hovering or clicking. It reveals tooltips and hyperlinks, e.g. see `constant "Example.path"` above, and thus explains how a certain piece of source text has been interpreted.

The combination of Isabelle/jEdit and the underlying semantic document-model should help users that are accustomed to Netbeans or Eclipse to approach formal logic and formalized mathematics. Thus we hope to see new generations of users continuing the tradition of the “LCF approach” from the 1970-ies.

3 Implemented concepts

Conceptually, the implementation consists of two main parts: (1) Isabelle/PIDE infrastructure in ML and Scala that is considered an integral part of the prover distribution, and (2) Isabelle/jEdit plugins and supporting code to assemble the main application. PIDE provides the main concepts for document-oriented interaction, and is most challenging to implement. Some aspects of previous versions are described in [3, 4], but the main issues are still unpublished. Compared to that the jEdit application is relatively small and simple: ≈ 100 Kb of Scala code.

The implemented concepts of Isabelle/jEdit in Isabelle2011-1 that are visible to end-users are as follows:

Continuous checking of source text while editing; no locking, no need to save intermediate files.

Dependency management between text buffers: each theory file corresponds to a node in the development graph of the current Isabelle session. Imports are resolved by reloading required files; edits on some node are propagated through the dependency graph as expected.

¹ <http://www.jedit.org>

Limitation: non-theory add-on files still need to be managed manually, to ensure that the prover loads the proper version.

Status overview of single text buffers and the overall prover session, with incremental update while the prover processes theories and proofs (usually in parallel on multi-core hardware).

Annotated input of source text, which is semantically decorated and physically highlighted via standard GUI metaphors.

Annotated output of prover messages, which is produced by traditional pretty-printing of the term language that is augmented by semantic markup. Rendering is delegated to HTML4/CSS on the JVM.

Limitation: no hyperlinks within the browser window yet.

Integration of Isabelle/ML into the Prover IDE: ML source inside Isar is fully annotated by the compiler, with inferred types and identifier scopes.

Integration of Isabelle/Scala into the jEdit *Console* plugin, which provides command line to access the running JVM via the Scala toplevel.

Limitation: only minimal IDE integration via terminal window.

Mathematical rendering of the source text based on Unicode characters, custom-made *IsabelleText* font with common glyphs from the T_EX repertoire, and sub-/superscripts via extended jEdit text styles

Limitation: only 1-dimensional layout following traditional text editing, no support for 2-dimensional boxes (fractions, roots, matrices).

Completion mechanism for mathematical symbols and keywords of the formal Isar language.

Limitation: based on static tables, no connection to semantic context yet.

Regular jEdit functionality and generic plugin can be used as well. The physical representation of formal sources coincides with JVM and jEdit conventions. So copy-and-paste or hyper-search of mathematical symbols does not cause any surprises to jEdit users.

References

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